ENVIRONMENTAL REGULATORY APPROACHES FOR PETROLEUM REFINERIES

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ABSTRACT

Many industrial, regulatory, and community leaders agree that the current U.S. environmental regulatory system imposes rigid requirements regardless of site-specific conditions, ignores the cross-media and multimedia environmental impacts that can result from these requirements, and lacks incentives for developing and using new technologies. For the foreseeable future, the U.S. petroleum refining industry, already challenged by thin profit margins and the need to manage releases of chemicals that can produce adverse impacts on the environment, will be required to produce higher quality fuels from poorer quality feedstocks. This paper describes two alternative environmental regulatory approaches to enhance environmental responsibility and maintain economic performance. These approaches are designed for existing petroleum refineries operating in the future. They differ from the current regulatory system in that they are multimedia in scope, provide for new technology development and use, and allow flexibility in how environmental goals are met. Various stakeholders, including industry representatives, regulators, local community groups, and national environmental organizations reviewed and critiqued early versions of the approaches. With minor modifications, the resulting approaches could be adapted for use by industries outside the refining sector.

INTRODUCTION

The 30-year-old "command-and-control" environmental regulatory structure in the United States has resulted in significant environmental improvements. Recently, however, its limitations (e.g., rigid application regardless of site-specific conditions, disregard of cross-media and multimedia impacts, limited incentives for new technology development and use) have become increasingly apparent. U.S. industries need new regulatory approaches that recognize current and anticipated economic constraints, new information on environmental processes and impacts, and the benefits of new technologies. Such approaches will be particularly important for the U.S. petroleum refining industry, which operates under thin profit margins, releases chemicals that can produce adverse health and environmental impacts, and must meet the technological challenges of producing more highly refined fuels from poorer quality feedstocks.

Under a grant from the Environmental Technology Initiative (ETI), a program established by the U.S. Environmental Protection Agency (EPA) to accelerate environmental protection and strengthen the U.S. industrial base, with cofunding from the U.S. Department of Energy (DOE), we developed two alternative environmental regulatory approaches for today's petroleum refineries to use in the future. These approaches are designed to increase the use of innovative technologies, encourage pollution prevention, demonstrate environmental responsibility, and maintain refinery economic performance.

These approaches differ from other regulatory reform efforts in several ways. For example, they recognize that the changing characteristics of refineries operating in the future and the environmental impacts associated with those changes will require fundamentally different regulatory structures. Rather than suggesting targeted, short-term modifications to existing media-specific, command-and-control regulations, these new approaches are broader and more flexible. They address crossmedia and multimedia impacts. They recognize that offering refineries flexibility in meeting environmental protection goals can stimulate new technology development and use. Unlike most EPA reinvention efforts, which seek results within 12 to18 months, this ETI effort assumes a time frame of 20 years or more. It also assumes that existing laws and regulations can be changed.

METHODOLOGY

We used an iterative and interactive process that integrated background information and stakeholder input to develop the alternative approaches, which were constantly revised and improved during the study. The process consisted of collecting background information, developing strawman approaches (i.e., preliminary approaches that were subject to review and revision), obtaining stakeholder input on those approaches, and refining the approaches to incorporate that input. This iterative process will be continued by testing the approaches and incorporating new information.

Collect Background Information

First, we established guidelines and principles to bound the study and set parameters for developing the approaches. Thus, for example, the approaches address refinery operations but not exploration and production or product use. Next, we examined existing and projected environmental laws and regulations affecting petroleum refineries to identify areas needing change. To understand future challenges and opportunities, we then described the projected refinery operating environment in terms of feedstock, product, technology, and economics. We found that feedstock quality was decreasing because of increasing crude densities and sulfur concentrations, that product demand for lighter fuels was increasing, and that new technologies would be needed to meet the challenges presented by using lower quality feedstocks to produce higher quality fuels. Finally, we identified several goals and indicators to assess and compare the alternatives. Goals included environmental responsibility, economic performance, and pollution prevention technology innovation and use.

Develop Strawman Approaches

On the basis of this background information, we identified more than 60 options for efficiently and effectively protecting human health and the environment. These options ranged from fundamental changes in environmental regulatory philosophy to procedural improvements in implementation. After evaluating these options against the goals and indicators, we distilled two separate thematic paradigms — a risk-based paradigm and a goal-based paradigm. We then created two draft, framework-level strawman approaches reflecting these paradigms to serve as starting points, which would then be revised and developed on the basis of input from potentially affected parties.

Obtain Input from Potentially Affected Parties

We held workshops with representatives of seven potentially affected interest groups to exchange information and obtain input for revising and improving the approaches. Small, one-day workshops, each following the same format and each attended by representatives from a single interest group, promoted candid dialogue. Separate workshops were held with representatives of petroleum refiners and trade associations, EPA headquarters offices, Texas and Louisiana state regulatory representatives, Texas and Louisiana citizens groups, national environmental groups, Mid-Atlantic state regulatory representatives, and Mid-Atlantic citizens groups.

Refine Approaches

By using the information obtained during the workshops, in combination with additional research on regulatory reinvention approaches being developed and tested in the United States and abroad, we revised the draft strawman approaches to provide more detail and clarification. The resulting approaches thus benefit from critical stakeholder review and incorporate aspects of other approaches tested in other industries and locales.

TWO DRAFT STRAWMAN APPROACHES

We developed two draft strawman approaches — a risk-based approach, called the Risk-Based Bubble or RBB, and a goal-based approach, called the Negotiated Performance Agreement or NPA. Both strawman approaches, and the current regulatory system, can be characterized according to a common structure consisting of the following three components:

1. Establish a baseline (identify a starting point for setting limits on residuals, or pollutants, released to the environment).
2. Set release limits (determine allowable residuals that can be released by the refinery).
3. Assure compliance (develop compliance tools to ensure that the releases limits are not exceeded).

Each of these components contains various elements or options that distinguish a given approach. Thus, the current system could be characterized, in a crude and oversimplified manner, as establishing a baseline for residuals on the basis of statutes and regulations, setting release limits frequently on the basis of technology, and assuring compliance via single-medium permits with limited incentives for pollution prevention or new technology development.

Both the RBB strawman approach and the NPA strawman approach differ thematically from the current regulatory system. The key difference between the RBB strawman approach and the current system is that in the RBB, risk provides the basis for setting release limits. As a result, releases can be traded across environmental media and residuals. The key difference between the NPA strawman approach and the current system is that in the NPA, the refinery and the regulators jointly negotiate the limits to achieve reductions from refinery-specific baseline releases.

Some of the elements common to both strawman approaches include the following:

- When establishing the baseline, the regulator and the refiner jointly identify residuals for which release limits must be established.

- The refinery and the regulator jointly specify release limits on a facilitywide rather than a source-specific basis. A facilitywide permit documents the release limits.

- Incentives provide the basis for assuring compliance, and flexibility in the compliance method is encouraged. Penalties apply if releases exceed the limits, and reporting requirements are streamlined relative to current practices.

Elements unique to the RBB strawman, identified by component, include the following:

- *Establish RBB baseline*. In addition to identifying environmental releases, the RBB baseline also characterizes site-specific environmental conditions and receptor information surrounding the refinery for use in setting the risk-based limits.

- *Set RBB release limits.* Jointly, the refinery and the regulator set release limits on the basis of risk to public health and the environment. The process for setting limits starts with establishing the residuals of concern on the basis of toxicity or other known health or environmental effects. Then, acceptable cumulative health and ecological risk levels are established for the site-specific receptors and conditions identified in the baseline. The process uses risk models to establish residual-specific release limits, which are designed to keep risk within acceptable levels. The regulator and the refinery reexamine the limits periodically to incorporate new information or changed conditions.

- *Assure RBB compliance.* Refiners can select or develop their own approaches for meeting the limits, and they can trade releases across media and residuals on the basis of risk. Linking of electronic monitoring results with risk models will facilitate trading and help assure compliance.

Elements unique to the NPA include the following:

- *Establish NPA baseline*. The NPA baseline inventories both current releases and environmental management costs. The baseline provides a starting point for identifying more cost-effective environmental management options.

- *Set NPA release limits*. Limits are negotiated to achieve residual- and media-specific reductions, which are expressed as percentage or actual reductions from the baseline.

- *Assure NPA compliance*. The negotiated performance agreement specifies the release limits and compliance assurance requirements, which remain in force for a specified period of time. Progress in reducing releases is measured against the baseline. If limits or reduction goals are not met, affected interests (e.g., local citizens) may be compensated.

STAKEHOLDER INPUT

We conducted workshops early in the approach-development process to obtain and incorporate input from potentially affected parties. At each workshop, a facilitator solicited comments and feedback on the three-component structure and the two strawman approaches. Participants provided constructive criticism, candid observations, and thoughtful suggestions for improving the approaches.

Comments Common to Both Approaches

Most workshop participants agreed that the current environmental regulatory system needs improvement. However, opinions varied regarding the degree and nature of required change, and participants stressed the need to see more details before they could endorse or oppose specific elements or approaches. Other commonly expressed comments included the following:

- *Meaningful public participation is required throughout the process.* Trust among stakeholders, industry, and regulators is necessary, and increased stakeholder participation can increase trust.

- *Environmental and economic goals are equally important.* Several participants noted that the approaches should not favor economic goals over environmental goals; any new approach must provide both environmental and economic benefits.

- *Approaches need good performance indicators and measures of success.* At least two types of indicators will be required. One type should measure health and environmental improvement, and a second should evaluate the performance of the approaches.

- *Implementation issues must be addressed.* The draft approaches contain elements significantly different from those of existing regulatory programs. Most participants observed that some federal laws and regulations would have to be changed in order to implement either of the strawman approaches.

Workshop representatives also commented on the specific elements or options of the two approaches.

Comments on the RBB

Most of the comments on the RBB strawman approach sought clarification and details on how the concept of risk would be used. Many participants endorsed the concept of a risk-based approach but questioned how the RBB could be implemented, given the number of unanswered technical questions. Examples of specific comments and questions related to the RBB strawman approach, organized by component, include the following:

- *Establish RBB baseline.* What criteria would be used to identify residuals of concern? How would the residuals and other environmental information from nearby sources that are necessary for characterizing the environment be obtained and used in the characterization? What kinds of quality assurance/quality control procedures would verify information obtained from various sources?

- *Set RBB release limits*. How would cumulative risk be defined? How would acceptable risk levels be determined? How would uncertainties be addressed? Where would the data come from? (Most participants stated a strong preference for data obtained from exposure-point monitors over data obtained from computer models.) Under what conditions would reopeners (opportunities to reexamine the limits) occur?

- *Assure RBB compliance.* How would cross-pollutant and cross-media trading of releases be accomplished and tracked? How would releases eligible for trading be identified? How and where would monitoring be conducted? How could citizens obtain monitoring results?

Comments on the NPA

Regarding the NPA strawman approach, most participants sought additional explanation and clarification, and many stressed the need for public participation in all components. Examples of specific NPA-related questions include the following:

- *Establish NPA baseline.* Would residuals be ranked (e.g., to reflect differing human health effects), or would they be given equal weight? What would prevent refineries from setting the baseline lower than it actually is in order to show progress relative to that baseline? Could the baseline be considered a target, thereby limiting incentives to improve beyond the baseline levels?

- *Set NPA release limits.* Who would conduct the negotiations? What would be the roles of the negotiators? How long would the NPA last? How would the NPA account for changes in production and environmental conditions that could increase releases or make goals otherwise inappropriate? How would flexibility be built into an agreement designed to last for several years?

- *Assure NPA compliance*. What, if any, compliance milestones would the refinery need to meet during the course of the agreement? How would penalties be structured, and could they be assessed prior to the end of the agreement? How would affected interests be compensated? How would information be made available to the public?

REVISED APPROACHES

Because workshop participants generally stressed the need for more detail and clarification rather than specifically endorsing or rejecting one approach over the other, we revised both approaches to incorporate the requested detail and clarification. To answer participant questions and to provide support for specific concepts embraced by

the two approaches, we supplemented our own thinking with findings of other regulatory reinvention and risk assessment efforts.

Revised RBB

Under the RBB's definition of allowable refinery releases, the total risk resulting from all releases and all sources, when considered in the context of the surrounding community, must not exceed a predetermined, total, cumulative acceptable risk level. Setting the release limits requires consideration of several site-specific factors, including types of residuals released from the refinery, individual residual toxicities, exposure pathways, and exposed populations. The RBB treats refinery operations as though a bubble surrounds the plant, with source-specific releases coming from the bubble rather than from individual stacks. The approach considers the synergistic and cumulative effects of residuals released from the refinery and from nearby facilities that affect public health and the environment. Because the controlling factor is total risk, residual-specific releases can be modified or exchanged with other releases, as long as the total risks from all residuals and the individual risks from specific residuals remain within the acceptable levels. The approach allows plant managers flexibility in controlling releases from disparate sources, as long as total cumulative risk remains acceptable.

Many of the workshop participants' concerns about the RBB, particularly those regarding the implementation of risk-related provisions, are nontrivial. These concerns will likely be resolved, however, through several existing efforts to expand risk-related data collection, coupled with the increasing number of government and nongovernment organizations calling for increased emphasis on risk in regulatory reform efforts. . Then the RBB could be demonstrated, at least on a pilot scale, within the next 15 to 20 years. Examples of these efforts include the following:

- The EPA's Risk Screening Environmental Indicators (RSEI) project incorporates information and models to provide a screening-level, risk-related perspective for comparing chemical releases, thus enabling users to consider chemical toxicity, exposure quantities, and population characteristics (1).

- The Presidential/Congressional Commission on Risk Assessment and Risk Management created a framework for environmental health risk management intended to "catalyze a new generation of risk-based environmental and health protection" by enabling risk managers to address multiple contaminants, sources, and exposure pathways (2).

- The EPA's *Guidance for Conducting Health Risk Assessments of Chemical Mixtures,* which supplements it's earlier guidelines on health risk assessment of chemical mixtures, reflects "evolutionary scientific development in the area of chemical mixtures risk assessment" (3).

- The EPA's Cumulative Exposure Project estimates exposure levels of toxic contaminants for different communities and demographic groups nationwide (4).

- The EPA's *Draft Economic Incentive Program Guidance* discusses, among other things, current thinking on trading of toxic air pollutants (5).

Significant, specific modifications and amplifications incorporated into the revised RBB to address workshop comments include the following:

- *Decision-making process.* The revised RBB envisions a decision-making body consisting of a defined number of representatives that balances the need to represent the views of all stakeholders with the need to operate efficiently and effectively. This "RRB Board" would include representatives of the refinery, appropriate regulatory agencies, and local citizens. It would be responsible for approving the baseline, the risk-based limits, and the compliance assurance measures.

- *Involving the public.* The revised RBB incorporates two levels of public participation in all three components. The first level consists of local citizens who represent broad community values. They participate in the activities of the RBB Board and assume long-term, active roles in implementing the RBB. The second level brings together community representatives who may not have the time or desire to be on the RBB Board, but who are interested in the process. They can contribute by communicating with the community, exchanging information, or otherwise consulting with and for the RBB Board.

- *Establishing the baseline.* The purpose of the RBB baseline is to provide information to develop refinery-specific release limits. Although these limits can change, and releases can be exchanged as long as the risks associated with those releases remain within acceptable levels, the baseline provides an initial starting point. To establish the baseline, the RBB Board should direct the following five activities:

    1. Develop an inventory of refinery-specific releases (whether or not currently regulated).
    2. Characterize the environment affected by releases by using information collected under other auspices (e.g., EPA monitoring efforts), combined with information from local citizens, and reviewed for scientific objectivity.
    3. Characterize residuals of potential concern by using existing risk assessments and other peer-reviewed scientific literature.
    4. Screen/prioritize residuals for setting release limits by using data from other research efforts (e.g., the EPA's RSEI project).
    5. Document and communicate results.

- *Setting limits.* The RBB sets release limits to target resources toward activities and releases that contribute the most to total human and ecological risk. The goal of setting residual-specific release limits is to ensure that releases from the refinery, when combined with other residuals in the environment, will result in a total cumulative risk level that is considered acceptable by all potential stakeholders. Cumulative risk refers to the potential risks presented by multiple stressors in the aggregate; it recognizes that combinations of residuals from various sources through various environmental media over various time periods affect human and ecological receptors. Several ongoing cumulative risk projects serve as models for setting release limits in the revised RBB. Such projects include EPA's Chicago Cumulative Risk Initiative, which strives to measure and reduce cumulative risk to Chicago-area residents (6); EPA's Total Risk Integrated Methodology (TRIM), a multipollutant, multimedia, multipathway assessment model to help evaluate and regulate health risks from air emissions (7); and EPA's *Human Health Risk Assessment Protocol for Hazardous Waste Combustion Facilities*, which assesses risks of hazardous waste combustors from direct and indirect pathways (8). No single existing model can project the total cumulative risk associated with releases of all refinery residuals combined with all other residuals in the area to which human and ecological populations may be exposed. However, given the growing interest in risk-based approaches and the increasing understanding of chemical hazards and exposure effects, we anticipate the development of a cumulative risk modeling system that will use existing and to-be-developed information on residual toxicities, interactions among residuals, cause-and-effect relationships, fate and transport, and dose-response relationships in conjunction with site-specific data to calculate total cumulative risk as well as the risks associated with individual residuals. This cumulative risk modeling system will help set release limits that reflect uncertainties in data and methods and will provide a means to track and help assure compliance.

- *Assuring compliance.* The revised RBB gives a refinery flexibility in selecting compliance methods to assure that refinery releases do not result in a total cumulative risk that exceeds the agreed-upon acceptable limits or in releases of specific residuals that could result in excess risk or "toxic hot spots." The RBB assures compliance through the use of direct, real-time monitoring of releases and resulting concentrations linked to the cumulative risk modeling system. This system would also track residual exchanges. Release data and resulting risk levels would be publicly available via the Internet, accompanied by explanatory reports highlighting refinery actions to reduce pollution, penalties imposed, monitoring data, and public participation activities. The release limits and the penalty

structure contain incentives to use exposure-point monitoring rather than modeled data.

- *Providing for risk-based release exchanges.* A key element of the RBB is the ability to exchange or trade releases across residuals and media on the basis of risk. Such exchanges, which are designed to provide flexibility in meeting environmental goals, are expected to occur primarily within the refinery bubble. However, under certain circumstances, exchanges between the refinery and one or more nonrefinery sources may occur. The ability to exchange is based on the assumption that risk provides the measure, or the currency, on which exchanges can be made. The cumulative risk modeling system will account for cross-pollutant and cross-media exchanges by running various combinations of the refinery's releases to identify residual-specific release limits that will keep total cumulative risk within acceptable levels. Thus, releases that produce a high risk would be reflected in an increased cumulative risk, and if that risk exceeded the acceptable risk level, the exchange would not occur. Exchanges can be prohibited for certain residuals until residual actions and interactions are sufficiently understood so that exchanges will not result in unacceptable risks. As information on the appropriateness of certain air pollutants for trading is developed, adjustments can be made to account for uncertainties.

- *Evaluating performance.* The revised RBB includes two types of indicators — environmental indicators and performance indicators. Because the RBB links releases to health and ecological benefits, it can be argued that by design, the approach contains a built-in environmental indicator. However, because the link between releases and risk relies on assumptions, other measures may more accurately indicate changes in human health and the environment. Thus, the revised RBB incorporates additional environmental indicators (e.g., local disease rates linked to refinery emissions, fish-tissue advisories). Performance indicators (e.g., greater public access to information, cost savings) measure the effectiveness of the RBB in meeting its goals.

- *Resolving implementation issues.* RBB implementation concerns include technology requirements, information for setting risk-based limits, and institutional resistance. As noted, the RBB is not intended to be implemented immediately; therefore, over time, increased scientific and technical knowledge, combined with expanding regulatory reinvention processes, should help resolve these issues. However, many of the RBB provisions (e.g., multimedia approaches, participatory standards development process, use of risk in setting limits) conflict with existing federal and state laws and regulations, and legislative change may be required to implement the approach. We

identified the following three options for mitigating statutory implementation issues: (1) a pilot-study waiver included in an appropriations bill that would allow the EPA to waive environmental requirements necessary to implement the RBB on a pilot scale; (2) a strategic waiver that would allow the EPA to waive compliance for any number of refineries (or other entities) for which the EPA, the regulated entity, and other stakeholders could reach agreement; and (3) individual statutory changes that would permanently modify specific environmental statutes to enable implementation of reforms such as those contained in the revised RBB.

State laws and regulations could also inhibit RBB implementation, because they can be more stringent than federal rules. To identify potential implementation constraints and possible facilitating mechanisms, we reviewed existing environmental regulations in Texas, a state with many refineries and a progressive environmental regulatory system. While most environmental regulations in the State of Texas are not considered more stringent than their federal counterparts, some Texas programs have no corresponding federal program. Also, certain Texas procedural requirements (e.g., public notice requirements) could slow state implementation. However, Texas is developing regulatory initiatives that could facilitate RBB implementation. These include the use of regulatory flexibility orders, which allow applicants to propose alternatives to current rules; flexible air permits, which allow for plantwide emissions caps; the Texas Risk-Reduction Program, which uses risk assessment techniques to set protective concentration levels in environmental media; and the permitting of "grandfathered facilities" to help ensure that all sources of releases are identified and that compliance requirements are based on local health considerations.

Another potential implementation concern is that a given refinery operating under the RBB approach potentially could be solely responsible for ensuring that the acceptable cumulative risk level in the community would not be exceeded. A new industry in the community, operating under the existing, non-risk-based regulatory system, could conceivably release residuals, thereby increasing cumulative risk and requiring the refinery to adjust its releases to ensure that the acceptable cumulative risk level would not be exceeded. To mitigate this potentially unfair scenario in a pilot test of the approach, the RBB Board could agree that the residuals contributed by the new facility would not "count" toward the previously established cumulative risk level. In the longer term, it is expected that the RBB would apply to all industries, so that the refinery would not be unfairly targeted.

Revised NPA

The revised NPA is a goal-based, facilitywide, multimedia regulatory program that incorporates several innovative regulatory concepts found in alternative approaches being implemented in the United States and abroad. The baseline, which includes an inventory of residuals and an inventory of environmental management costs, reflects current, refinery-specific operating conditions and provides a starting point for negotiating release limits and a benchmark for measuring progress toward meeting those limits. In the revised NPA, a council that includes representatives of the refinery, appropriate regulatory agencies, and local citizens groups negotiates release limits. The limits are negotiated on the basis of goals established by state or federal environmental policies, or by the parties involved in the negotiations and current refinery operating conditions, and releases and should not exceed existing and anticipated future regulatory limits. The resulting negotiated performance agreement would remain in effect for a negotiated period of at least 10 to 15 years. At the end of the period, the refinery would be expected to have met its release reduction goals. To provide for continuous improvement, the limits could become more stringent over time, and milestones could be set to assess progress.

The revised NPA gives the refinery more flexibility in meeting its environmental protection goals than the current system. Thus, rather than requiring the refinery to meet a variety of source-specific technology, permitting, scheduling, and other requirements, the revised NPA allows the refinery to use the most cost-efficient and effective means it can identify to meet the NPA goals. The revised NPA envisions an electronic reporting system that is integrated with emissions monitors to reduce staff burden and increase reporting accuracy. Compliance in the revised NPA is assured, in part, by publicly available reports.

Many of the revised NPA elements are similar to those of other successful regulatory innovations being developed and implemented nationally and internationally. These include the EPA's Project XL program, which offers increased flexibility in how a facility meets its environmental responsibilities (usually via relief from a specific regulation) in exchange for "superior environmental performance"; the Netherlands Covenants Program, in which representatives of industrial sectors negotiate with regulatory agencies to establish certain environmental goals for the sectors to meet over a specified time period; and comprehensive state environmental permits. Several states (e.g., New Jersey, Oregon, Texas) have begun implementing comprehensive, facilitywide, or multimedia permits to reduce regulatory burden, increase operational flexibility, and provide equal or better environmental performance. Each of these programs shares common elements with the revised NPA. However, none is identical in all aspects. For example, XL projects are generally much narrower in scope than the revised NPA, which seeks to substitute negotiated limits for all pollutants from all media in a single agreement. In the Dutch program, covenants are signed at the sector level rather than at the facility level, and those covenants are tied to national-level environmental goals. The NPA envisions agreements negotiated at the refinery level, and the revised NPA calls for the negotiated limits to reflect refinery-specific goals set at the beginning of the process. Comprehensive state permits share the concept of regulating pollutants from all media in a single, facilitywide permit, but they generally rely less on public participation and negotiation than the revised NPA. Regardless of the differences

between these programs and the revised NPA, each provides support for the development and testing of the approach.

Most of the workshop comments on the NPA pertained to the need for additional detail and meaningful public participation in all three components. Some participants suggested improving the NPA structure by adding an initial component to establish refinery-specific NPA goals. Additional detail and clarifications incorporated into the revised NPA to address workshop comments include the following:

- *Involving the public.* The revised NPA includes public participation in all three components via a refinery-specific "NPA Council." The NPA Council would consist of 20 to 25 representatives from the refinery, the regulatory agencies, and the local citizenry. A suggested model would include six voting members and 14 to 19 nonvoting members. The voting-member component would be similar to the RBB Board in that it would include representation (suggested to be two each) from the refinery, the regulatory agencies, and the local citizenry. Nonvoting members could include other refinery or parent company representatives, additional regulatory agency representatives, additional citizen group representatives, local elected officials, and representatives of national environmental groups. The NPA Council would oversee initial goal formulation, baseline establishment, release limit negotiations, and compliance assurance.

- *Establishing goals.* Some workshop participants suggested that a goal-setting component added to the beginning of the process would help guide the baseline-establishment process, assist in negotiating the release limits, and aid in scaling incentives and penalties for compliance assurance. Goals could be expressed in terms such as types of residuals to be reduced, environmental impacts to be mitigated, pollution prevention expectations, or anticipated new technology implementation. The revised NPA includes the establishment of refinery-specific NPA goals as a first step in the NPA development process.

- *Establishing the baseline.* The purpose of the revised NPA baseline is to provide a benchmark for setting release limits and for assessing progress in meeting those limits. As such, it should reflect current operating conditions at the refinery. To establish the baseline, the NPA Council would oversee the following three activities:

    1. Development of an inventory of refinery residuals.
    2. Development of an inventory of refinery environmental management costs.
    3. Documentation of results.

Facilitywide observations, interviews, record reviews, and other methods would be used to identify refinery-specific residuals, regardless of whether those residuals were currently regulated. Designating release sources would facilitate the identification of pollution prevention opportunities. To ensure a manageable scope of this potentially resource-intensive task and to account for potential differences in residual toxicities that might affect how the limits would be set, the NPA Council might use a screening process for prioritizing residuals to be measured in the baseline. Factors to consider in such a screening process might include national goals, human health effects data, and interactions among refinery releases and other constituents in the local environment. The results of the residuals baseline should be publicly available, for example, by posting on the Internet.

Because any benefits associated with implementing an alternative regulatory program that are realized by a refinery will be measured by reduced costs, an accurate identification of baseline environmental management costs can give the refinery a realistic basis on which to measure the impacts of the NPA. Environmental costs are frequently misallocated (generally to overhead) and thus can be difficult to track, evaluate, and reduce. The NPA Council should consider using total cost allocation methods described in the current accounting literature to facilitate the cost collection activities. The NPA Council will need to consider confidentiality issues regarding public access to cost data, and it should review confidentiality programs in states such as New Jersey where such programs have been implemented successfully.

- *Setting limits.* As does the revised RBB, the revised NPA calls for limits to be set on a refinery-specific rather than on a source-specific basis. However, in contrast to the RBB, the revised NPA does not allow for trading of releases across residuals and media within the bubble. Nonetheless, the revised NPA is a multimedia permit, because it incorporates release limits for multiple residuals and media in a single document. When setting the limits, the NPA Council should consider various factors, including the refinery-specific NPA goals, baseline emissions, current regulatory requirements, anticipated regulatory requirements, recent investments by the refinery to reduce emissions, and potential changes in refinery production. In addition to residual-specific limits, the permit may also include such performance measures as the introduction of new process or control technologies, incorporation of stakeholder views in the decision-making process, reduced time and effort for compliance assurance activities, and cost savings to the refinery and the regulator. The negotiated performance measures will be publicly available through such venues as the Internet.

- *Assuring compliance.* The revised NPA requires more interaction among affected stakeholders in assuring compliance than traditional permitting approaches. The NPA Council develops compliance assurance mechanisms, which may include public participation in activities such as inspecting monitors or developing more meaningful reports. The revised NPA does not necessarily require less reporting, but it does require more efficient, effective, and transparent reporting. For example, the linking of NPA reports with electronic monitoring results should enhance speed and accuracy. Revised NPA reports should also discuss pollution prevention results, describe other refinery actions taken to ensure that releases do not exceed limits, and provide examples of enhanced public participation.

  The revised NPA includes compliance incentives. For example, the amount or frequency of reporting can be reduced if the refinery meets the limits ahead of schedule or if it produces fewer releases than allowed in the agreement. The revised NPA also specifies actions for which penalties to the refinery may be assessed and the nature of such penalties. The severity of penalties could be structured to increase or decrease, depending on the nature and extent of the violation. For example, penalties that link the cost per ton of residual exceeding the limit to the potential harm of the residual could be assessed. The revised NPA allows fines and penalties to be used to benefit local communities. For example, the NPA Council could direct the revenue from penalties to specific projects (e.g., wetlands restoration, implementation of disease detection and treatment programs) within the local community. The agreement may also provide for severe violations to result in a reversion to the otherwise-applicable command-and-control regulations, in addition to high monetary penalties.

- *Addressing resource requirements.* Many workshop participants noted that developing and implementing an NPA would be time- and cost-intensive. However, most of the time and dollars for the NPA will be spent in the early stages (convening the NPA Council, setting the baseline and limits). Over the longer term, resource requirements are expected to decrease as stakeholders move along the learning curve, see the results of similar reinvention projects, and realize the benefits of electronic monitoring and reporting. The NPA Council can also limit resource requirements by using the established goals to prioritize residuals for which limits would be set.

- *Resolving jurisdictional and legal issues.* Implementing the revised NPA will require, at the least, a greater degree of communication and cooperation among various regulatory agencies than typically exists today, and it could require reworking the regulatory structure to accommodate a facilitywide, multimedia approach. One can be optimistic about

the occurrence of changes in these directions on the basis of experience in other countries such as the Netherlands, where the covenants program has required multiple federal, state, and local agencies covering various subject areas to meet together with individual companies to develop environmental plans consistent with covenant goals (9). The revised NPA, as does the revised RBB, envisions techniques (e.g., multimedia permits, incentives for pollution prevention) that conflict with certain existing environmental statutes. As does the revised RBB, the revised NPA will require modifications to some of these laws before it can be implemented. Such modifications can be accomplished via the same methods as suggested for the revised RBB: through pilot study waivers, strategic waivers for a number of refineries, or by amending the conflicting aspects of individual statutes.

NEXT STEPS

The theoretical aspects of the two alternative regulatory approaches have been vetted among federal and state regulators, corporate refinery personnel, and local and national environmental and citizen groups. The next step in the development process is to test one, both, or a combination of the two approaches in an actual refinery setting. As noted earlier, no major new refineries are expected to be built in the United States in the next several years. However, we are investigating the following three opportunities for testing the approaches on smaller domestic refineries or other foreign refineries:

1. Native American refinery operations. Currently no oil processing plants exist on Native American lands. The DOE is supporting cooperative efforts between Native American Tribes and the oil industry in the application of innovative petroleum technologies on Native American Lands that increase resource and economic development while protecting the environment. Currently, three separate tribes (in Montana, North Dakota, and Oklahoma) are exploring the development of refineries that would produce 10,000 to 20,000 barrels per day of tier 2 gasoline, diesel, and jet fuel. Any of these projects would provide a good opportunity for testing the approaches.

2. Venezuelan upgrading operations. Venezuela exports a significant amount of crude to the United States. However, this crude is very heavy and needs to be upgraded before it can be processed at U.S. refineries. As a result, the Venezuelan Oil Corporation, Petroleos de Venezuela (Pdvsa) is building "upgraders" to increase the existing crude viscosities (8–10° API) to 16° API or better. The DOE and the Venezuelan Ministry of Energy and Mines have a memorandum of understanding in the area of oil and petrochemistry ecology and environmental research, which could provide a vehicle for setting up a pilot test of the approaches at one of these upgraders.

3. Domestic, private-sector refinery expansions. As foreign sources of crude become less tenable, and demand for petroleum-based fuels

continues, some domestic refineries are likely to meet this demand by expanding existing operations, or at least modifying them to respond to lighter fuel needs. The approaches could be tested on such major refinery modifications.

If none of these opportunities comes to fruition, the approaches can still be tested via a hypothetical "paper test," which would entail working with refinery staff, regulators, and local citizens to provide the engineering basis for further application.

Any pilot test will require coordination and cooperation among diverse entities, and the work to date with various stakeholders provides a good foundation for such cooperation.

CONCLUSIONS

We have developed two future-oriented environmental regulatory approaches for petroleum refineries. These approaches, a risk-based approach (RBB) and a goal-based approach (NPA), strive to meet the potentially conflicting goals of environmental responsibility and economic performance through pollution prevention and new technologies.

The goal-based approach, because it requires less change to the current system and relies less on the findings of forthcoming scientific and technological research, may be more readily implemented in the near term. The risk-based approach, which requires the development, testing, and acceptance of modeling systems and data on parameters such as pollutant toxicities, exposure routes, dose-response relationships, and cumulative effects, will likely require more time to implement. However, various recently completed, ongoing, and projected studies on such models and data will provide much of the information needed to implement the RBB within a 20-year time frame, which is consistent with the overall project parameters.

In developing the alternative approaches, input was collected from potentially interested parties. Participants in seven workshops, each representing a particular interest group, generally supported the concept of developing future-oriented alternatives that provide flexibility and accountability for meeting environmental responsibility and economic performance goals. They also stated that the ETI-refinery project should build on the momentum established to date; the current regulatory system needs to be changed, and the ETI-refinery approach, given its integrated format and interaction with stakeholder groups, provides an appropriate format to do so. We addressed workshop participants' requests to provide more detail and clarification and to integrate public participation in each component of the approaches. In addressing the workshop comments, we combined the results of other regulatory reform and related research activities with our own thinking to revise the approaches. Thus, the approaches integrate a variety of reform ideas.

The revised approaches could now benefit from further comment and eventual pilot testing. Such experimentation, involving either a U.S. or foreign refinery or a hypothetical case study, would yield additional information to further improve and refine the approaches. Several individuals and organizations, including state regulators,

national environmental groups, and the EPA's Regulatory Reinvention Office, have expressed interest in participating in or tracking further development and implementation of the approaches. Perhaps more important, several local citizens groups endorsed the ETI-refinery approach, thereby increasing the likelihood of acceptance and implementation.

Developing the future-oriented alternative regulatory approaches for petroleum refineries has produced benefits beyond those originally expected. These include exchanging information with public interest groups on scientifically based approaches to environmental regulation, providing lessons learned to the EPA for its broader reinvention efforts, and enhancing the potential for applying these prototypes to other industrial sectors, both within and outside the oil and gas industry.

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